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REMBASS SPECIAL PROCESSING UNIT,(U)
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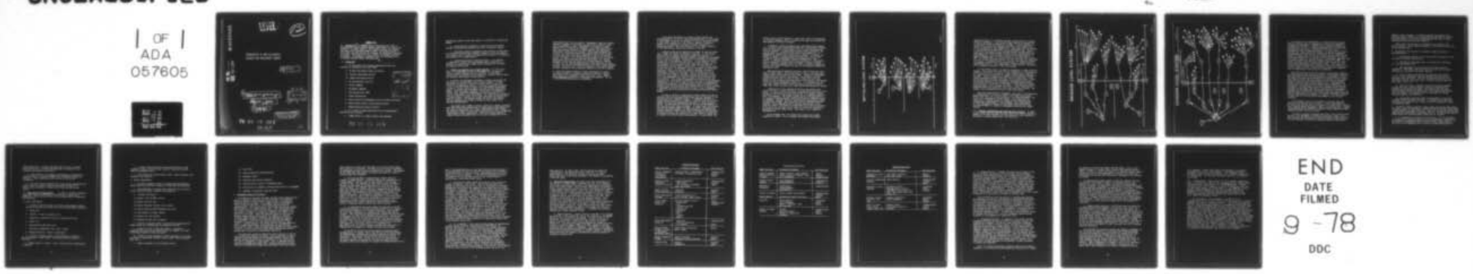

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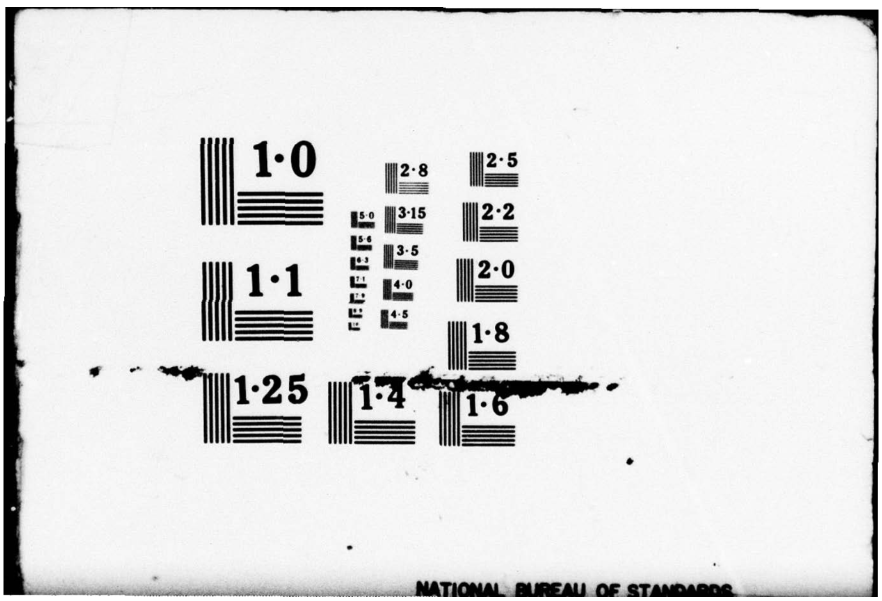
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REMBASS SPU

1A. Introduction: The REMBASS Special Processing Unit (SPU) is envisioned as a small computer display system which will assist the operator of a sensor system to plan, manage, monitor and analyze the inputs from a deployed sensor system. The primary purpose of this effort has been and will be to define the operational functions of the SPU. Also this effort will attempt to recommend algorithm development, to determine a reasonable size for the system, and to propose possible display configurations.

B. Background:

1. To this point the following organizations have been contacted in conjunction with this study:

a. US Army Intelligence Center and School

(1) Materiel Development Section

(2) Combat Development Section

b. US Army Research Institute

c. PM CAC, ERADCOM

d. PM ARTADS, CORADCOM

e. CSTA Laboratories, ECOM

f. Sandia Laboratories

g. Sensor Control and Management Platoon, 2d Marine Division

h. Remote Sensor Platoon, 82d Airborne Division

i. MITRE Corporation, Metrek Division

2. As a result of these discussions the following general conclusions can be stated.

a. A REMS system is a highly flexible and adaptable

surveillance system to the point where it is difficult to define and manage.

b. During periods of moderate to high activity the typical operator can effectively monitor only one or two sensor strings.

c. Alternative display techniques, while helpful in some cases, do not greatly increase the operator's capacity to monitor sensors. The volume of data is simply too complex and too great to be absorbed and understood by a human operator.

d. Automated processing techniques appear to be required in moderately to highly active situations such as expected in a European environment where a REMS could be deployed as a division and brigade level system.

II. Present and possible use of Sensor Systems: In view of the above, it is necessary to look at how sensors are utilized now with the present organizations and equipment. By reviewing present practices, insights can be gained into possible problem areas and possible limitations of sensor systems.

A. At present the employment of sensors is highly situational and the system is utilized under widely varying concepts. In some situations the system is used at battalion level or lower with little if any emplacement support. In other situations the system is used at division level or higher with considerable emplacement support to include high performance aircraft and long range patrol assets. With the present equipment, monitoring is an extremely tedious task, completely exhausting the monitoring team in 3 to 4 days in a moderately active environment. All analysis and processing of sensor outputs is manual and in some cases hand calculators are used as an assist. The present sensors are detect only sensors and any classification is made by either an audio sensor or by velocity discrimination.

The present use of REMS is greatly limited by a number of factors. Most peace time field exercises are of short duration and normally do not allow for emplacement of a large, comprehensive sensor system. The problem of sensor recovery and the accountability of an "expendable" item becomes a major consideration. There are varying degrees of command interest and appreciation in the use of sensors and of the

intelligence that they can provide. Consequently there are varying degrees of support to the sensor platoons both in physical terms and in psychological terms. Emplacement of sensors is a major problem and is a possible key weakness in the system particularly where the tactical situation is highly dynamic, and emplacement and recovery facilities are limited. With present equipment the inability to communicate sensor intelligence quickly and reliably to those that can utilize the information is also a key problem area of the system. The limited monitoring capacity of the present system, the short term field exercise environment, the limited emplacement resources available, the varying degrees of command interest, and the tenuous communications links available all tend to limit the size and comprehensiveness of any sensor system presently employed. The above also limits the operators of the sensor system in their thinking as far as possible concepts in the use of sensors.

B. While the present methods of sensor emplacement are useful in gaining insight into possible problems in the use of sensors, they should not be necessarily used as a guide to how a sensor system should be planned for, established, and operated. In view of this the following system is considered.

In the above discussion the concept "sensor systems" has been mentioned but it has not been precisely defined. At this stage of development it may not be possible, or wise, to precisely define a total sensor system due to the system's inherent flexibility. However it is necessary to develop an overall structure in a generalized manner. With this structure it will then be possible to more specifically define the functions of the SPU.

A sensor system can be employed at a number of tactical levels and in almost any number of tactical situations. At the various levels there are varying intelligence needs and interests. A battalion level commander has more immediate information requirements both in time and in space. Normally he is interested in activities no more than 10 kilometers to his front. At the battalion level, information of the early warning type is of most interest, so that the commander can be alerted to when, where and with what his subordinate units may come in contact with. At the division level, on the other hand, the commander is more interested in developing a complete picture to include any trends or patterns that may be developing. Sensors at this level could be anywhere from 50 to 150 kilometers forward of the FEBA. Also at the division level there are a wide range of information gathering systems that need to cue and supplement each other in order to better develop that total picture. This cuing and supplementary process is not only concerned with inter-system interactions, but also with intra-systems interactions. Not only is there a need to develop a comprehensive information gathering and processing system across the board on the division level but also within each system there is a need to develop a comprehensive system from division on down. This is necessary to make full use of the potentialities available from ground sensor systems.

In order to develop a comprehensive sensor system the tasks of planning, emplacing and monitoring sensors must be allocated to the various units in a systematic manner. A reasonable approach to accomplishing this would be to begin at division level and allocate sensors and monitoring responsibilities down to lower levels as needed. In some cases the division may dictate the emplacement of the divisions entire issue of sensors. In other cases, the division may hold the sensors completely under its control, emplacing only division monitored sensors. In other situations the division may allocate sensors to lower levels, some to be emplaced and monitored as Division dictates and others for the lower units to either hold in reserve or to use at their own discretion. In other words, the

division would allocate sensors to lower units, some to be monitored for division purposes, some to be used as the lower unit decides and some sensors to be held in reserve.

In general it would be expected that each sensor team assigned to a battalion would normally have about 20 to 30 sensors of various types of which some of that number will be in areas of brigade and division interest. A brigade would normally have around 50 to 100 sensors under its purview of which some of that number will be designated as sensors with division level interest. To handle this number of sensors, a brigade monitoring team would have to have a computer aided processing/or Special Processing Unit (SPU) device. At division levelthere could be between 100 to 300 sensors strictly devoted to division level interests. Again at division level it should be apparent there is a need for an SPU to manage and monitor this number of sensors, as well as the designated sensors of subordinate units.

When analyzing the manpower available, each division will have about 10 sensor teams. This would equate to about 1 division team, 3 brigade teams, and 6 battalion level teams. Alternative deployments, varying rear area security requirements, and different tactical situations would alter this mix of teams. These four men teams should be able to provide continuous 24 hour monitoring of the sensors, as well as limited emplacement capability. It is expected that the teams that operate the SPU's would not require any extra training other than a short orientation on operating and monitoring the system.

A description of the information flows in the various level system will give a clearer picture of the generalized functions of the system. At battalion level the sensor teams would normally emplace and monitor two to three sensors strings out to a maximum distance of about 10 kilometers. The sensor outputs would be received directly at a manual processing device, Sensor Monitoring Set (SMS)with relays if necessary. Here the operator would monitor and manually process the data from the SMS. Any significant activity detected would be reported to the supported units S-2 section and possibly a fire direction center. The means of accomplishing this could be digitally or by voice via land line, FM net radio, or a Tactical Information Distribution System (TIDS) device. See Figure 1 for a graphical representation.

At the brigade level, the system would receive two primary categories of inputs. In one category the brigade would emplace

BATTALION LEVEL SYSTEM

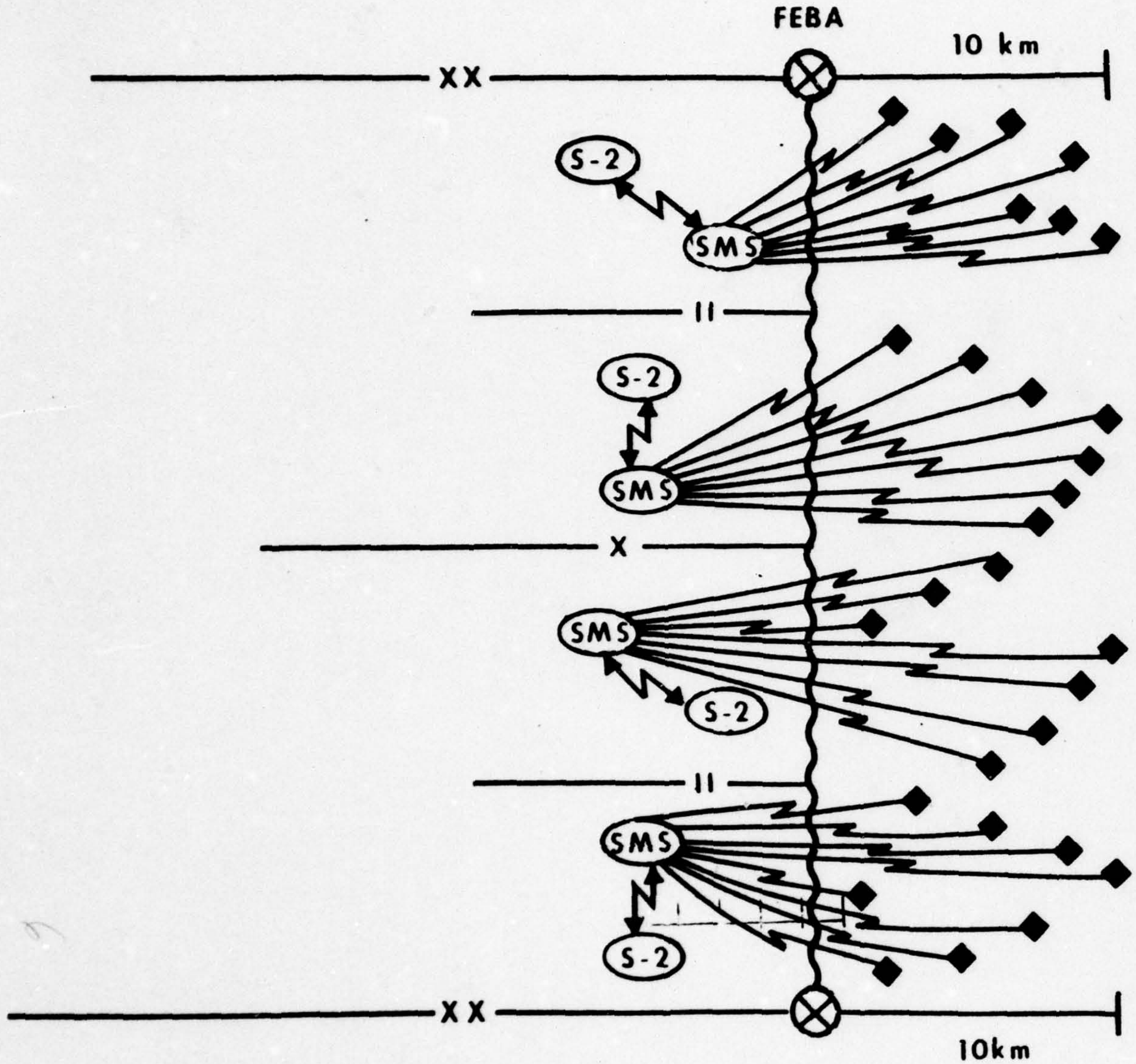

Figure 1

and monitor about 5 to 20 sensor strings or grids directly (through relays if necessary). These sensors would normally be emplaced out to around 50 kilometers forward of the FEBA. A second category of inputs would be data from designated battalion level sensors that may be of interest to the brigade level. This input would be relayed to the brigade SPU automatically and in unprocessed form. This is to prevent overloading the battalion SMS operator during periods of high activity and would provide a backup in case the battalion team was knocked out. This automatic relay could be accomplished by means of REMBASS relay or a TIDS attached to the output port on the SMS. The brigade SPU would process this data and relay any significant activity to the supported units S-2 section, fire direction centers, if necessary, and battalion level sensor teams to forewarn them of approaching activity. This communications would suffice. See Figure 2 for a graphical distance of this level system.

At the division level, the same two categories of inputs would be present. The division would be directly responsible for emplacing and monitoring its own set of sensors. These sensors would constitute up to 100 strings or grids out to ranges of 150 kilometers forward of the FEBA. Also the brigade level SPU would be instructed to relay certain designated sensors' activations to the division level. These activations could be either processed or unprocessed sensor data. The division SPU would relay information on significant activities to the division G-2 section via the EWIOC, to fire direction centers when applicable, and to brigade level SPU's. These links would be primarily digital although voice nets could serve as a back-up. See Figure 3 for a graphical depiction of this level system.

With this organizational arrangement, each level of the system can act independently of either the lower or the higher level system. However with each level linked together in a coordinated manner, the units form a comprehensive sensor system. This system has the flexibility to rapidly adjust to varying tactical situations and informational requirements of the commander. The effectiveness of this comprehensive system could be significantly greater than the effectiveness of a number of independent battalion size sensor systems.

III. <u>Planning, establishing and operating Sensor Systems</u>: In order to more clearly see the functions that could be provided by the SPU in support of the above systems, the steps required to plan, establish and operate a sensor system need to be identified.

BRIGADE LEVEL SYSTEM

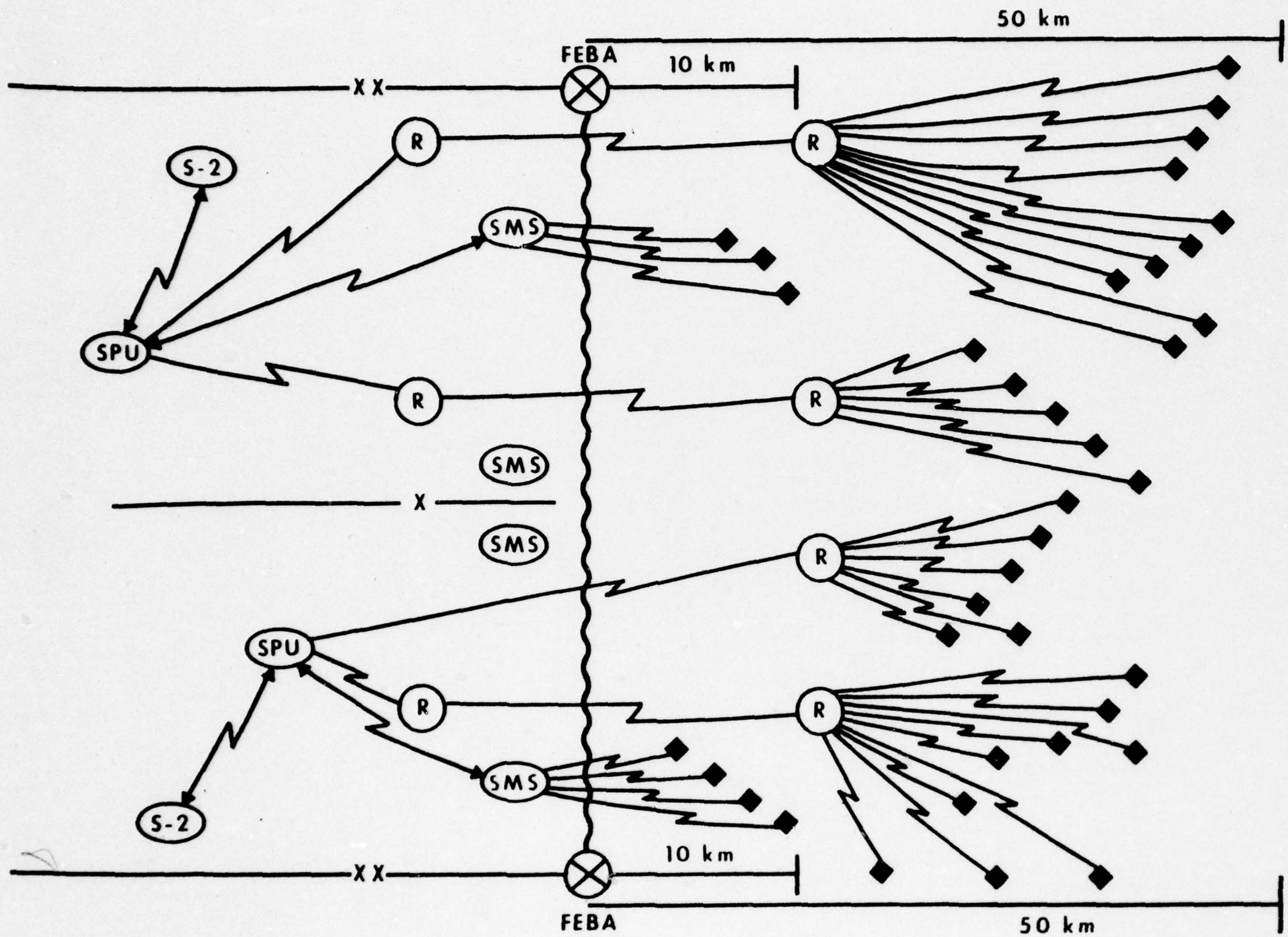

Figure 2

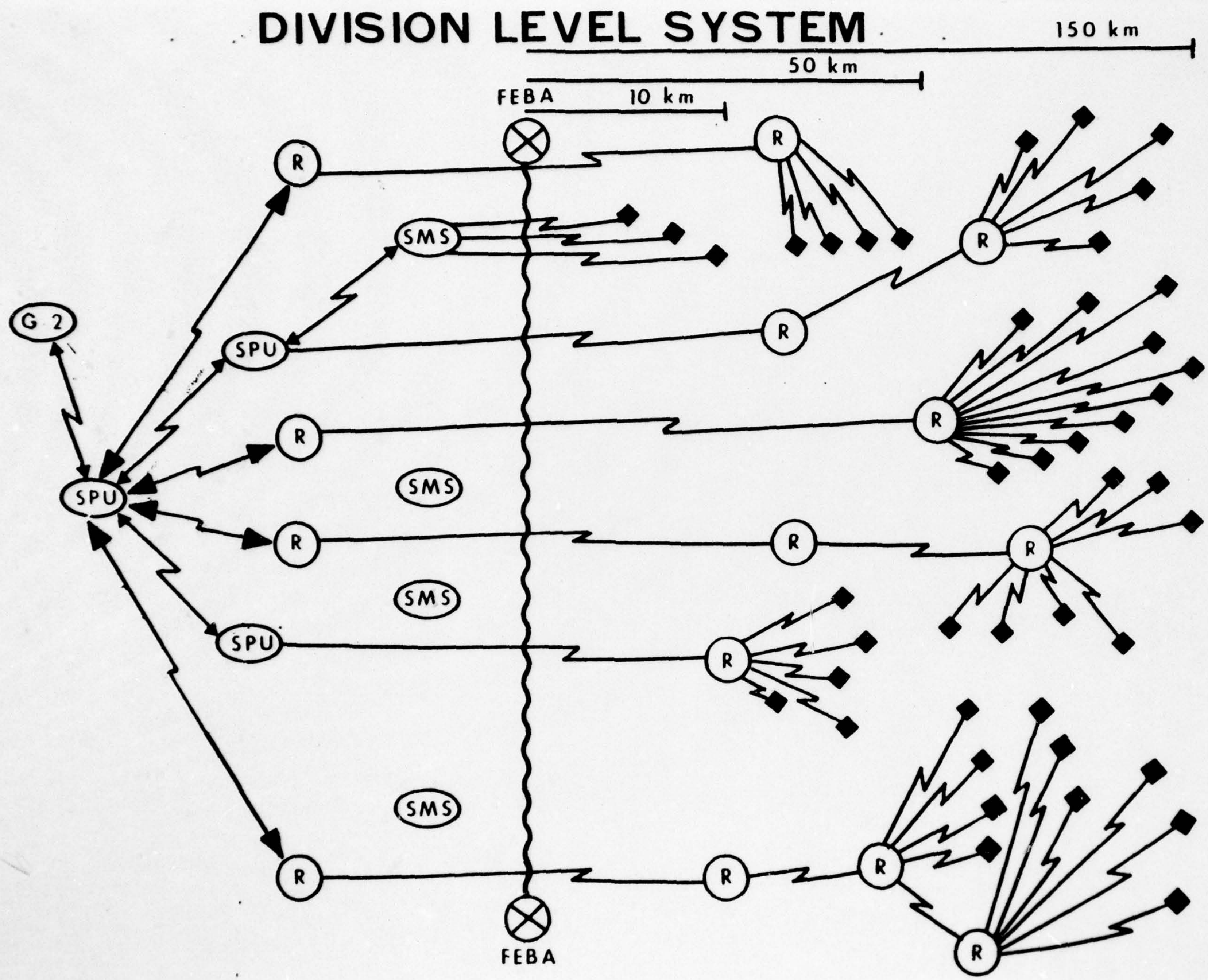

Figure 3

A. In planning for the employment of a sensor system the overall tactical situation must be considered to include the commander's information requirements. Adjacent units, possible movements and contingencies, as well as present deployments must be considered. Planning must take place in conjunction with and in close coordination with the supported element. In the future this sensor planning most likely would occur between the Mission, Management and Dissemination (MMD) section of the EWIOC and the sensor platoon leader. In addition to the overall tactical situation, the use of other RSTA systems and the availability of emplacement resources, time and physical means will greatly influence the use of a REMS. In order to properly plan the sensor operator must be able to quickly access maps, deployments, and operation orders. With these, the critical avenues of approach or retreat are selected as well as any critical areas or points. Areas outside the division's immediate area of responsibility should also be considered.

With the selection of critical areas to be covered by sensors, an emplacement strategy should be selected. Approximately where and what type sensors are to be emplaced should be determined, as well as whether the sensor should be emplaced in grids, belts or strings. This analysis should take into account the existence of emplaced sensors as well as their expected battery life. Existing sensor fields in adjacent tactical areas should also be considered. The availability of sensors as well as their present location must be considered. With the sensor availability determined and a general strategy and deployment selected the availability of emplacement resources can be determined. Emplacement resources include not only physical means such as artillery, air and hand emplacement means, but also the time available to emplace the sensors. The time available in many cases will be dictated by the dynamics of the tactical situation.

In developing a plan it is necessary to allocate teams and sensors to the various tactical levels, to assign areas/routes to be covered and how they are to be covered (i.e., grid, belts, strings), and to request/assign emplacement tasks to various resources. Terrain considerations and the presence of sensors already emplaced and their remaining battery life must be known.

In order to maintain continuous operations, close attention must be paid to the assignment of frequencies and sensor codes. Care must be taken that the RF profile for the system in conjunction with the codes available provides for compatible operation and correct

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reading of sensor outputs. It would be expected that higher level (corps or above) coordination of frequency and code usage is required. The establishment of relay chains where distance and line of sight conditions dictate must also be considered.

These above concepts must be considered in an iterative and parallel process. No one specific sequence of steps would be practical in the planning phase.

B. The general steps required to establish a sensor system are delineated below:

1. The requisite sensors, relays and batteries necessary for the field must be located and procured.

2. The means of emplacement must be confirmed and instructed as to the emplacement plan.

3. The emplacement of the sensors must be supervised and coordinated. The sensors must be of the proper type, on the proper frequency and code and at the proper location.

4. Once the sensors are emplaced the operator must receive reports of their emplacement from the emplacing units and as well as signals from the sensor. This will confirm that the field is in the proper location, the proper type, the proper frequency and code and proper operation.

5. There is a need to properly align the monitoring equipment so that the output from the sensors is properly interpreted and presented by the monitoring system. This implies that the output from the proper sensors are represented in the proper string or grid which is adjacent to the proper routes or areas and that the SPU accurately depicts this situation.

6. The operator then must report the emplacement of the field to higher levels for proper recording. Also higher levels should be notified of any shortfall due to lack of sensors, frequencies, relays or emplacement means.

C. In order to properly operate a sensor system the operator must monitor the sensor inputs for significant indications and must analyze those inputs to gain insight into enemy activities. When this is done the operator then must pass the information to the proper activity. To effectively operate a sensor system the following general steps must be followed:

1. In a moderately to highly active situation it will be necessary to decide upon or designate certain critical parameters or sensitivities. For example in designating detection sensitivities, single vehicles may be of little importance, but a convoy of tracked vehicles may be

highly significant. Certain areas monitored by lower or adjacent units may also be of interest and means must be provided for the reception and analysis of this data.

2. When important intelligence and information is acquired by operators there is a need to transmit this information quickly and reliably to those organizations that can act on and use the information.

3. As sensors become inoperable or if monitoring responsibilities change, there is a need to delete or add sensors as well as to alter critical parameters or sensitives of both the SPU and the sensors.

IV. Input and output Requirements: In order to properly accomplish these above steps, the SPU must be provided the following input parameters, and in turn must output the following types of information and assistance.

A. Input requirements:

1. In order to properly assist in planning and managing a sensor system the SPU must be provided with the following sensor parameters.

a. Sensor type

b. location - 8 digit coordinate (utm)

c. transmitter frequency and codes for sensors and relays

d. sensor life

e. monitoring and emplacing units

f. heirarchical membership (belt, grid, string)

g. expected detection radius of each sensor

2. In order to properly assist in the monitoring of sensors and the analysis of their output, the SPU must have in addition to the above:

a. sensor output to include: time of detection and classification if possible.

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b. A means of setting priorities and sensitivities to such variables as area, time, unit type, velocity, detection rate and vehicle or personnel count.

c. the location of various routes, paths, terrain features, unit boundaries and locations.

B. Output requirements:

1. In order to properly assist in planning and establishing a sensor system the SPU must be capable of outputting and displaying:

a. map backgrounds of varying scale along with unit locations, routes, critical terrain, features, and boundaries.

b. listings according to:

(1) sensor, relay and SMS location

(2) sensor and relay type

(3) sensor groupings (strings, belts, grids)

(4) sensor relays and SMS frequencies and codes

(5) time sequence of sensor reports

(6) reports sent and received

(7) expected battery life of sensors

2. In order to properly assist in monitoring and analyzing the sensor output the following must be provided by the SPU.

a. A means to alert or refer the operator, according to previously set priorities and sensitivities, to display on either a CRT/plasma display or hard copy output.

b. A method to rerun sensings in either compressed or real time according to a particular criteria (area or zone, time slice,sensor type, etc.).

c. reports according to the following criteria:

(1) unit types

(2) vehicle counts and classifications

(3) personnel counts

(4) direction and velocity estimates

(5) expected time of arrival at designated point

(6) notification of changes in velocity/directions or of stoppages

(7) sensings in designated times and areas

V. Man-Machine Function Allocation.

In attempting to allocate the above analyzed steps between man and machine a number of important points must be made. The essential functions required in the planning, establishing, and operating a sensor system are different. In a dynamic tactical environment it is quite possible that each of these phases would be going on simultaneously. Also the activity on the battlefield can vary greatly from no activity to a highly intense level. The system must allow for flexible allocation of functions between man and computer and there must be a means of allowing one component to be aware of the activity of the other. While the human has superior abilities in decision making and pattern analysis, the computer is superior in speed, memory capacity, monitoring and computational accuracy. It is necessary to allocate the functions such that the human is adequately utilized but not over loaded during periods of high activity. During periods of low sensor activity the human should be able to engage the planning, system checking and book-briefing functions of the SPU. Also the computer must perform only those tasks to which it is well suited and invoke human interventions when the machine detects activity of questionable importance.

The human must be able to perform at least a portion if not all of the tasks that confront the system. This is necessary in case of complete or partial failure of the automated system. On the other hand the machine should be able to perform all of the simple tasks at least in a degraded or crude manner. This is necessary when the human is performing such higher level, abstract functions as those involved in planning and integrating intelligence from other sources.

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There should be no doubt that the human is the final decision maker and controller in the system. The human sets the critical parameters and determines the mode in which the machine will operate. The machine, on the other hand, must support and assist and guide the human as decision maker and integrator.

A. The planning phase of implementing a sensor system is primarily a human function. Planning involves the consideration of a large number of factors, many of them abstract, over varying periods of time. The computer can most readily assist the human by storing and displaying the varying aspects of those factors in a flexible manner. The computer should be able to accept and store maps, unit locations, critical terrains, designation and boundaries. Operations orders and special instructions should be readily stored and recalled. The availability and location of sensors must be readily displayable. As discussed in paragraphs IV and V the SPU needs to be able to accept, store and display not only sensor system data per se but also information concerning the tactical situation. Being able to readily access and display this information in a flexible manner will greatly enhance the sensor platoon leader's ability to formulate sensor plans quickly and effectively.

B. In establishing the sensor system the functions of giving instructions/requests, receiving confirmations/reports, and aligning the monitoring equipment are of primary importance. Here the SPU can be of great assistance in formatting and transmitting orders/requests. Also adjusting and changing sensor inventories and locations as necessary will help future planning and operations. The SPU must be configured such that the operator can easily and reliably align the system such that the inputs are received, processed and displayed properly. That is that the correct sensor activations are processed and displayed at the proper locations. As movements are made and/or areas of interest change the manner and orientation of displays must be changed in a flexible and non-tedious manner.

If the SPU can receive the various reports concerning sensor implementation in a digital format, the SPU can relieve the operator of acknowledging, recording and verifying reception of signals from that sensor. This process can be recalled and verified by the operator at a later time. The SPU can also notify the operator of any sensor reported as emplaced but for which no signal has been received as well as the reception of signals from sensors which are not

part of the prescribed plan, or any other deviation from the plan as it was registered with the SPU. The SPU can also assist by keeping a historical record or reports received, acknowledges send and turn on times for the various sensors. If the SPU can accomplish the above, the operator will be relieved of much of the tedious burden of establishing a functioning sensor system.

C. Operating the sensor system will require close interaction between the operator and the SPU. The SPU can best assist the operator by monitoring the activity level of the sensors, performing mathematical calculations and comparisons,and separating and storing the sequence of sensings. The operator on the other hand, must ensure the system is operating correctly, must set and adjust sensitivity parameters, and must make final determinations as to the significance of a series of activations. Again in sending sensor intelligence and alerts to higher and lower units, the SPU can assist the operator in formatting, addressing, sending and acknowledging the receipt of messages. During periods of low activity the operators may want to monitor and analyze all of the sensors activations. As activity increases the operator must assume more of the system supervisor and controller functions while the SPU assumes much of the monitor and basic analysis functions. At any rate, it is the human who makes the final judgment as to the importance or significance of a series of activations. The SPU's function is to provide the operator with the information necessary to make that determination in a fast and flexible manner with minimum specialized training. While the operator is accomplishing this function the SPU is continually scanning the sensor outputs for other indications of significant activity and doing necessary calculations.

D. It is important to note that the three phases of implementing a sensor system: planning, establishing and operating are not separate and distinct. It is quite possible in a dynamic situation that all three phases would be going on concurrently. Consequently the SPU must support the operator in all three phases concurrently. For example the operator in planning for a future movement may use the SPU to assess the availability of sensors. At the same time the SPU could be receiving and acknowledging emplacement reports, and continuously monitor those sensors that are emplaced for any significant activity. The operator should be able to query the SPU for information at any time and be displayed that information in a very short response time. While it should be clear that the human operator is the controlling element in the system, the SPU should be able to carry out most of its functions without the aid of the

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human operator. In other words, once the system is aligned and in operation the SPU should not become "hung" due to a lack of human response. The SPU would continue to analyze and store significant sensor activations according to the sensitivity parameters it was last given.

VI. Functional Requirements: The exact functional requirements for the SPU are, to a great degree, dependent not only on the hardware and software interactions but also on the human-machine interactions within the overall system. The following tables depict the general steps or human functions required to plan, to establish and to operate a comprehensive sensor system. Again, the exact sequence of steps is not critical and in many cases the functions will be of a iterative or parallel nature. To accomplish these steps or functions certain information must be provided either by the human to the SPU, from the SPU to the operator, or to or from external elements. This information to be exchanged is depicted generally in the center column on the tables.The last column on the tables depicts the general function required at each step by the SPU to assist the human in performing his/her functions. These SPU functions have been divided into the general categories of memory, both storage and retrieval; displays; processing; and communication. A somewhat more detailed explanation of these functions follows:

A. Memory Function: A major function of the SPU is the storage and retrieval of data needed not only by the operators of the REMBASS system but also the users of the systems. All data stored by the SPU should be capable of being stored in a secure, non-volatile manner to prevent loss of data due to power failure or system malfunction. Also such data as system programs and formats should be stored in a Read Only Memory (ROM) or in such a manner to prevent accidental loss or erasure, or tampering. The design of this memory system should allow selected retrieval of single pieces of information as well as the sequential retrieval of blocks or groups of information. There should also be a means to systematically purge the memory of unneeded or obsolete data.

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Planning Functions

Human Functions	Information Exchanged	SPU Functions
receive commander's information & intelligence requirements	operator orders, coordinations with EWIOC or supported units	communications displays memory
analyze tactical deployments (present & future)	friendly deployments - RSTA assets - unit locating & boundings enemy deployments	communications displays memory
select critical areas and points	locations boundaries	displays memory
select emplacement strategy	location/boundaries for belts, strings, and/or grids	displays memory
locate sensors relays, and batteries	emplaced sensors & relays - coordinates - type - frequency and code - battery life - membership inventory - type - location - number	memory communications displays
locate emplacement resources	- land units - artillery batteries - air resource	communications memory
Assign sensors, strings, & relays to emplacement and monitor units	sensor types & locations units & teams	memory
assign frequencies & codes	corps or division frequency & code allocations	displays memory
formulate plan	formats assignments	displays memory

Establishing Functions

Human functions	Information Exchanged	SPU Functions
locate & request sensors batteries & relays	sensor location, types, numbers sensor requisition numbers, types unit assignments	memory displays communications
confirm & issue tasking	task assignments acknowledgements	communiations displays
supervise & coordinate	instructions acknowledgements conformations	communications
receive & validate sensor reports	initial reports from sensors implantation report from units	communications displays memory
align SPU	sensor reports task assignments sensor - frequency, codes and locations	processing memory display
reports to higher elements	overlays shortfall reports request for additional resources	communications memory display

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Operating Functions

human functions	information exchanged	SPU functions
designate critical parameters	size, speed, direction unit type, zones	memory displays
receive & assimulate sensings	sensor reports	communications displays memory
determine critical sensings	processing reports sensings runs in real or compressed time according to: zone, time, sensor type, belt, string, etc.	processing memory displays
estimate velocity direction, unit type	sensings designation target parameters	processing memory display
report to appropriate units (upper, lower, FDC)	message formats intelligence reports & warnings	communications display memory

B. Display Function: Possibly the most critical aspect of the SPU is the manner and method in which the human and the machine components of the system interact. The primary point of interface will be the display system of the SPU. A plasma or CRT display with a keyboard and some type of cursor control would constitute this point of interaction. The human should be able to enter the sensor locations, routes, boundaries, etc., graphically through the use of cursor control. The use of the keyboard to enter alpha-numeric data should be kept to a minimum while the amount of data input through menu selection should be maximized. In order to minimize training on the system, the SPU will lead the operator through the various steps. The operator at every step will be presented with a list or menu of options as to the action to be taken on the next step.

Since the SPU will have the ability to simultaneously perform the functions of planning, establishing and operating the SPU should have the capability to alert the operator to significant activity. A notification presented on the periphery of the display would allow the operator to continue work on the task in progress or to switch to the significant task immediately. The capability of a multiple or split screen display should also be considered. During any activity, the SPU must be able to notify the operator of the occurrence of previously designated events. It would then be the operators' option to continue the activity or to stop the immediate task and divert attention to the designated or significant event.

C. Processing Functions: In addition to the normal internal processing functions required for control of displays, memory, and communication equipment, the SPU will need additional processing capabilities in order to properly assist the operator in planning, emplacing and monitoring a sensor system. As each sensor report is received it must be tagged by the SPU with a time of arrival. This tagging is important for later processing. Also as each input is received, whether from the display/keyboard or from external sources it should be screened for obvious errors. These type errors would include frequency and code assignments that are out of assigned ranges, location that are obviously out the area of interest, etc. If errors such as this are detected the SPU should query the operator for a correction, or under direction of the operator to query the sender to correct and retransmit.

Also, if a sensor continuously transmits reports while sensors adjacent to it are inactive the SPU should have the ability to request

the operator to delete that sensor from the system. Also, in the opposite context if a sensor fails to report when adjacent sensors report, the SPU will notify the operator of a possible inactive sensor. Also when an end of life transmission is received, the sensor will automatically be deleted and a notification displayed to the operator by the SPU.

In receiving each sensor report the SPU will identify the type and location of the report, screen it for possible errors, and compare this report with any report received from nearby sensors. If the type, location, or frequency of the reports are within the bounds of pre-established thresholds, the operator will be notified. Velocity, direction and vehicle mix will also be reported to the operator. Estimated time of arrival at designated points for designated target types will be calculated and reported to the operator when appropriate. The precise means or algorithms to accomplish this process are not specified. A number of algorithms are available with varying degrees of performance. Trade-offs must be made between memory requirements, false alarm rate, error rates, and capability of the algorithm or algorithms.

D. Communications Functions: The SPU must have the capability of sending and receiving messages via landline, FM net radio, or a TIDS type system. At a minimum, a division level SPU should have the ability to interface with three brigade level systems,the division G-2 or EWIOC, and appropriate artillery control centers in addition to receiving sensor inputs from the division level sensors. The brigade level SPU's must be able to interact with the brigade S-2, supporting artillery control centers and subordinate battalion level systems, as well as receiving sensor inputs from brigade sensors. The SPU must be able to receive messages simultaneously. This will require the use of buffers in the system in order to prevent the loss of possible valuable information.

Also the SPU will record the receipt and sending of messages, as well as assist the operator in formulation and formatting message. For certain designated situations the SPU will automatically send notifications to external elements such as subordinate units or supported operations center. The SPU will have the ability to place messages into the formats required by TACFIRE, TOS, EWIOC and other automated systems, without the direct intervention of the operator. Again transmission of messages, unless in the designated situations where transmission is automatic, the operator will merely select which elements are to receive a message and the SPU

will address, format and ensure the message is properly transmitted via the proper model. The communications equipment required by the SPU will be integral components of the system. Set-up and teardown time will be held to a minimum.

VII. Conclusions: The intent of this concept paper has been to tentatively define the organizational, operational and functional requirements of the REMBASS SPU. These concepts are to be viewed as a point of departure for the further development of this aspect of the REMBASS system. As the sensors themselves and the systems with which REMBASS is to interoperate become more developed, the user requirements for developing and operating the SPU will come into sharper focus.

As foreseen in this document the SPU will be transportable by a 1¼ ton truck or be contained in a armored command and control vehicle (M-577). This size limitation and the continuing development of processing algorithms may force a trade-off among the various functions to ensure the memory and processing capabilities of this system are not overloaded. At present it is not possible to determine which functions the user will find most critical or most helpful. These insights will become available only through hands-on experience with the user. Also this system is not envisioned, particularly in this early development stage, to be a rigidly defined system. Once in the hands of the user there should be the flexibility in the system to allow for certain tuning and adjusting of the system to meet the needs of a particular situation. This system is intended to be evolutionary and one that is capable of continual adaption to changing requirements and tactical environments.